

THOMAS ELECTRONICS, INC.

## Flat Fluorescent Lamps for Displays

*Every cockpit in a large airplane contains small windows that are mainly used when the plane is on the ground. While flying, pilots see the world not by looking out the windows, but by looking at the text and images shown by instrument displays mounted on the walls of the cockpit. The quality of these images bears directly on the quality of the flying.*

### COMPOSITE PERFORMANCE SCORE

(based on a four star rating)

One Star

### More-Visible Instrument Displays for Safer Flying

Today, almost every cockpit display uses cathode ray tube (CRT) technology. CRTs are a proven technology, have a long history and are fabricated by Thomas Electronics — which undertook this ATP project — for use in the manufacture of cockpit displays. CRT displays, however, have a well-known drawback: the surface is glass, and the view one gets through it

---

*In some circumstances, such as bright sunlight, visibility of displays may be seriously diminished.*

---

depends on the amount of light in the cockpit and the direction the light is coming from. In some circumstances, such as bright sunlight, visibility of displays may be seriously diminished.

### Creating a Flat Fluorescent Lamp

Liquid-crystal displays (LCDs) — the flat-panel displays used in notebook computers — would be a good alternative to CRT displays. The drawback to LCDs, however, is that their light source is not nearly bright enough for use in airplane cockpits. This ATP project addressed that problem by developing the technology needed to make a flat, bright fluorescent lamp for backlighting an LCD. The new lamp would be about a



Flat fluorescent lamps for flat panel display backlighting, in a variety of sizes, ranging from 1.5 inches to 12.5 inches on the diagonal.

quarter of an inch thick, have the same length and width as the LCD, and be attached to its back.

In conventional fluorescent lamps, a cathode discharges electrons that excite mercury vapor to emit ultraviolet light that, in turn, induces the phosphor coating on the interior of the lamp to glow white. Flat

## PROJECT HIGHLIGHTS

### Project:

To develop a high-efficiency electron source for fluorescent lighting to enable a new class of efficient, bright, flat lamps with wide applications in computer and instrument displays, high-definition TV displays and

**Duration:** 2/1/1994 — 1/31/1997

**ATP Number:** 93-01-0109

### Funding (in thousands):

ATP	\$ 718	77%
Company	215	23%

### Accomplishments:

Thomas developed the high-efficiency electron source needed to construct flat fluorescent lamps, which was the goal of the project. The company achieved the following:

- entered pilot production of flat lamps for key customers in the U.S. display industry;

- received orders for further evaluation and field testing of the new technology in cockpit applications from Optical Image Systems, AlliedSignal, Honeywell, Litton Industries, Kaiser Electronics, and five other companies; and

- placed prototypes with three military contractors for rugged displays in tanks and other ground vehicles.

### Commercialization Status:

Current sales of prototypes and pilot models of flat fluorescent lamps to avionics customers range from 30 to 50 units per month. If customer tests prove the technology works for them, regular commercial sales are expected to begin after the flat-panel displays have been certified by the Federal Aviation Administration for use in cockpits.

### Outlook:

Full commercialization is expected after refinements to the technology based on feedback from customers using prototype units. If the technology is commercialized, its users — aircraft manufacturers, airlines and their passengers — will benefit from brighter, more reliable and cheaper backlights for flat-panel displays in airplane cockpits.

### Composite Performance Score: \*

### Company:

Thomas Electronics, Inc.  
100 Riverview Drive  
Wayne, NJ 07470

**Number of Employees:** 251 at project start,  
324 at the end of 1997

**Contact:** Douglas Ketchum

**Phone:** (973) - 696-5200

**Informal Collaborator:** Princeton University

fluorescent lamps were not developed earlier because of the difficulty in generating a bright plasma in the thin space between wide, flat sheets. Conventional cathodes are too inefficient to create enough light for the color LCDs used in avionic displays. And although barium dispenser cathodes (BDCs) are efficient enough for the task, they were never used in the presence of mercury, which is believed to poison the barium and quickly reduce both

---

*Flat fluorescent lamps were not developed earlier because of the difficulty in generating a bright plasma in the thin space between wide, flat sheets..*

---

the efficiency and life span of the device. Thomas solved the mercury problem with BDCs by using a new hollow-cathode design that enabled the company to construct a truly flat fluorescent lamp.

In addition, Thomas introduced new materials to flat fluorescent lighting. The front of the lamp is glass. But the back is harder ceramic material and has all the light-producing components embedded in it. The ceramic back enables the lamp to withstand severe shock and vibration much better than if both sides were glass. In addition, the thermal properties of the ceramic material allow the lamp to operate at significantly higher temperatures than comparable lamps made solely of glass. As a result, these new lamps can be used for rugged flat-panel displays in applications such as military tanks.

### Field Testing Underway

Follow-on research and development work is on track to meet the project's commercialization goal — the introduction into commercial and military airplane cockpits of flat-panel displays containing the new fluorescent lamp. To date, Thomas has invested more of its own money in the effort than it received from ATP, and the work is beginning to pay off. The company is completing a pilot production plant and has received

orders for further evaluation and field testing of the new technology from Optical Image Systems, AlliedSignal, Honeywell, Litton Industries, Kaiser Electronics and five other companies. The field testing must yield positive results before the Federal Aviation Administration will certify the flat-panel displays for use in cockpits.

About 10,000 displays are installed in airplane cockpits each year. Compared with CRT devices, the new flat-panel displays will be more effective (they produce more light), more reliable (the ceramic material is harder than glass), and less-costly (the ceramic material can be machined more easily than glass). Ultimately, their use is expected to benefit aircraft passengers, who will

---

*... these new lamps can be used for rugged flat-panel displays in applications such as military tanks.*

---

enjoy safer air travel because pilots have more-effective, more-reliable instrument displays. It is also expected to benefit flat-panel display manufacturers, aircraft manufacturers and airlines through cost reductions and quality improvements.

Potential uses for the flat-lamp technology include displays in military ground vehicles, such as tanks. Displays in these applications must withstand greater extremes in vibration, temperature, and other operating conditions than ordinary displays. Three companies specializing in such displays have ordered flat-lamp prototypes from Thomas.

### **ATP Bolsters U.S. Technology**

Without the ATP award, Thomas officials say, the company would not have done the research and development work for this project. The company would struggled along with its conventional CRT technology

---

*Without the ATP award . . . the company would have stood virtually no chance of competing with other display-component suppliers, all of which are foreign companies.*

---

and would have stood virtually no chance of competing with other display-component suppliers, all of which are foreign companies. In addition, the award helped

Thomas establish connections with scientists at Princeton University and form alliances with contractors.